

WHAT IS CLAIMED IS:

1. A material removal head for removing materials from one or more wells of a multi-well plate, the material removal head comprising at least one tip that:
 - 5 a) comprises at least one vent opening, at least one inlet and at least one outlet, which inlet communicates with the outlet; and
 - b) is structured such that when the inlet is disposed proximal to a selected well from which a material is to be removed, the tip forms a barrier between the selected well and at least one adjacent well;
- 10 wherein when the outlet is operably connected to a negative pressure source, air is drawn through the vent opening and into the inlet, thereby noninvasively removing material from the selected well while the barrier prevents cross-contamination of the adjacent well.
- 15 2. The material removal head of claim 1, wherein the tip is structured such that when the inlet is disposed proximal to the selected well, the tip forms a barrier between the selected well and three adjacent wells.
3. The material removal head of claim 1, wherein the tip is coupled to a body structure of the material removal head by a resilient coupling.
- 20 4. The material removal head of claim 1, wherein the material removal head comprises multiple tips.
5. The material removal head of claim 1, wherein the material removal head comprises at least one manifold.
- 25 6. The material removal head of claim 1, wherein the material removal head comprises at least two tips, wherein the inlets of the tips are spaced at a distance that substantially corresponds to a distance between at least two wells disposed in a multi-well plate.

7. The material removal head of claim 1, wherein the material removal head comprises a plurality of tips in which centers of at least two of the inlets of the tips are spaced 18 mm, 9 mm, 4.5 mm, 2.25 mm, or less apart from one another.
8. The material removal head of claim 1, wherein the material removal head is structured to noninvasively remove materials from a plurality of multi-well plates substantially simultaneously.
9. The material removal head of claim 1, wherein the tip is structured to noninvasively remove fluidic material from the selected well.
10. The material removal head of claim 1, wherein the tips comprise a cross-sectional shape selected from the group consisting of: a regular n-sided polygon, an irregular n-sided polygon, a triangle, a square, a rectangle, a trapezoid, a circle, and an oval.
11. The material removal head of claim 1, wherein the tips are structured to noninvasively remove materials from multi-well plates that comprise 6, 12, 24, 48, 96, 192, 384, 768, 1536, or more wells.
12. The material removal head of claim 1, wherein a cross-sectional area of the tip is less than a cross-sectional area of at least one well disposed in a multi-well plate.
13. The material removal head of claim 1, wherein at least one section of the tip comprises an acute edge.
14. The material removal head of claim 1, wherein the material removal head further comprises at least one mounting bracket that mounts the material removal head to at least one device component.
15. The material removal head of claim 1, wherein the tip comprises angled surfaces that mate with sides of the selected well.
16. The material removal head of claim 15, wherein one of the angled surfaces comprises the vent opening that allows air passage into the selected well.

17. The material removal head of claim 16, wherein the tip comprises an acute edge that forms a boundary of the vent opening.
18. The material removal head of claim 1, wherein the tip comprises a seal material disposed around the tip.
- 5 19. The material removal head of claim 18, wherein the seal material comprises rubber or another compliant material.
20. The material removal head of claim 18, wherein the vent opening is formed between the seal material and one side of the tip, which vent opening allows air passage into the selected well.
- 10 21. The material removal head of claim 1, wherein the material removal head comprises a plurality of tips, at least a subset of which comprises a footprint that substantially corresponds to a footprint of at least a subset of at least one line of wells disposed in a multi-well plate.
- 15 22. The material removal head of claim 21, wherein the number of spacing regions disposed between adjacent tips in a line of tips is a multiple of the number of spacing regions disposed between adjacent wells in a corresponding line of wells disposed in the multi-well plate.
- 20 23. The material removal head of claim 1, further comprising the negative pressure source operably connected to the outlet, which material removal head and negative pressure source together comprise a material removal device.
24. The material removal head of claim 23, wherein the negative pressure source is integral with the material removal head.
25. The material removal head of claim 23, wherein the negative pressure source comprises a pump.
- 25 26. The material removal head of claim 23, wherein the negative pressure source applies a pressure of at least 28.5 inches Hg at the inlet at a flow rate of at least 0.3 cubic feet per minute.

27. The material removal head of claim 23, wherein at least one tube operably connects the negative pressure source to the outlet.

28. The material removal head of claim 23, wherein the material removal device is hand-held.

5 **29.** The material removal head of claim 23, further comprising at least one trap operably connected to the material removal device, which trap is structured to trap waste material.

30. The material removal head of claim 23, further comprising at least one valve operably connected to the material removal device, which valve regulates
10 pressure flow from the negative pressure source.

31. The material removal head of claim 30, wherein the valve comprises a solenoid valve.

32. A material removal head comprising at least one vent opening, at least one inlet and at least one outlet, which inlet communicates with the outlet,
15 wherein the inlet is structured to noninvasively remove material from at least one selected well disposed in at least one multi-well plate when the outlet is operably connected to at least one negative pressure source, and wherein a surface of the material removal head that comprises the inlet is structured to substantially seal at least one non-selected well in the multi-well plate when the inlet is disposed proximal to the
20 selected well from which the material is to be removed.

33. The material removal head of claim 32, wherein the surface of the material removal head that comprises the inlet is substantially flat.

34. The material removal head of claim 32, wherein at least one section of the inlet comprises an acute edge that separates the inlet from the vent opening.

25 **35.** The material removal head of claim 32, further comprising the negative pressure source operably connected to the outlet, which material removal head and negative pressure source together comprise a material removal device.

36. The material removal head of claim 35, wherein the negative pressure source is integral with the material removal head.

37. The material removal head of claim 35, wherein the negative pressure source comprises a pump.

5 **38.** The material removal head of claim 35, wherein the negative pressure source applies a pressure of at least 28.5 inches Hg at the inlet at a flow rate of at least 0.3 cubic feet per minute.

39. The material removal head of claim 35, wherein at least one tube operably connects the negative pressure source to the outlet.

10 **40.** The material removal head of claim 35, wherein the material removal device is hand-held.

41. The material removal head of claim 35, further comprising at least one trap operably connected to the material removal device, which trap is structured to trap waste material.

15 **42.** The material removal head of claim 35, further comprising at least one valve operably connected to the material removal device, which valve regulates pressure flow from the negative pressure source.

43. The material removal head of claim 42, wherein the valve comprises a solenoid valve.

20 **44.** A material removal head comprising at least one tip that extends from the material removal head, which tip comprises at least one vent opening and at least one inlet, wherein the material removal head further comprises at least one outlet that communicates with the inlet, wherein the inlet is structured to noninvasively remove material from at least one well disposed in at least one multi-well plate when
25 the outlet is operably connected to at least one negative pressure source thereby drawing air through the vent opening and into the inlet, and wherein the tip is structured to mate with the well from which the material is to be removed to form a barrier

between the well and one or more adjacent material-containing wells when the material is removed.

5 **45.** A material removal head comprising at least one vent opening, at least one inlet and at least one outlet, which inlet communicates with the outlet, wherein the inlet comprises a first cross-sectional dimension that is less than a first cross-sectional dimension of at least one well disposed in at least one multi-well plate and a second cross-sectional dimension that substantially corresponds to at least a segment of a length of at least one line of wells disposed in the multi-well plate, which inlet is structured to noninvasively remove material from one or more wells disposed in
10 the line of wells when the outlet is operably connected to at least one negative pressure source and wherein a surface of the material removal head that comprises the inlet is structured to substantially seal at least one other well in the multi-well plate when the inlet is disposed proximal to the well from which the material is to be removed.

15 **46.** A dispense head comprising at least one dispenser that is structured to dispense material into one or more wells of at least one multi-well plate, which dispenser is angled relative to a Z-axis so that the material is dispensed onto the sides of the wells when the dispenser is operably connected to a material source and the material is dispensed from the dispenser.

20 **47.** A multi-well plate processing system, comprising:
a) at least one material removal head comprising at least one tip that:
i) comprises at least one vent opening, at least one inlet and at least one outlet, which inlet communicates with the outlet;
and
ii) is structured such that when the inlet is disposed proximal
25 to a selected well from which a material is to be removed, the tip forms a barrier between the selected well and at least one adjacent well;
wherein when the outlet is operably connected to a negative pressure source, air is drawn through the vent opening and
30 into the inlet, thereby noninvasively removing material

from the selected well while the barrier prevents cross-contamination of the adjacent well;

b) at least one positioning component that is structured to position one or more multi-well plates relative to the material removal component; and/or,

5 c) at least one dispensing component that is structured to dispense one or more materials into one or more wells of one or more multi-well plates.

48. The multi-well plate processing system of claim 47, wherein the material removal head comprises multiple tips.

49. The multi-well plate processing system of claim 47, wherein the tip
10 is coupled to a body structure of the material removal head by a resilient coupling.

50. The multi-well plate processing system of claim 47, wherein the tip is structured to mate with the selected well from which the material is to be removed.

51. The multi-well plate processing system of claim 47, further comprising a negative pressure source, wherein the operable connection between the
15 outlet and the negative pressure source comprises at least one manifold.

52. The multi-well plate processing system of claim 47, wherein the material removal head comprises at least one manifold.

53. The multi-well plate processing system of claim 47, wherein the material removal head comprises at least two tips that are spaced at a distance that
20 substantially corresponds to a distance between at least two wells disposed in a multi-well plate.

54. The multi-well plate processing system of claim 47, wherein the material removal head comprises a plurality of tips in which centers of at least two of the inlets of the tips are spaced 18 mm, 9 mm, 4.5 mm, 2.25 mm, or less apart from one
25 another.

55. The multi-well plate processing system of claim 47, wherein the material removal head is structured to noninvasively remove materials from a plurality of multi-well plates substantially simultaneously.

56. The multi-well plate processing system of claim 47, wherein the material removal component is structured to noninvasively remove fluidic material from the multi-well plate.

57. The multi-well plate processing system of claim 47, wherein the tip
5 comprises a cross-sectional shape selected from the group consisting of: a regular n-sided polygon, an irregular n-sided polygon, a triangle, a square, a rectangle, a trapezoid, a circle, and an oval.

58. The multi-well plate processing system of claim 47, wherein the tips are structured to noninvasively remove materials from multi-well plates that
10 comprise 6, 12, 24, 48, 96, 192, 384, 768, 1536, or more wells.

59. The multi-well plate processing system of claim 47, wherein a cross-sectional area of the inlet is less than a cross-sectional area of a well disposed in a multi-well plate.

60. The multi-well plate processing system of claim 47, wherein at
15 least one section of the inlet comprises an acute edge.

61. The multi-well plate processing system of claim 47, wherein at least one tube operably connects the negative pressure source to the outlet.

62. The multi-well plate processing system of claim 47, wherein the negative pressure source comprises a pump.

63. The multi-well plate processing system of claim 47, wherein the
20 negative pressure source applies a pressure of at least 28.5 inches Hg at the inlet at a flow rate of at least 0.3 cubic feet per minute.

64. The multi-well plate processing system of claim 47, wherein the dispensing component comprises at least one dispenser that aligns with one or more
25 wells disposed in one or more multi-well plates when the multi-well plates are disposed proximal to the dispenser.

65. The multi-well plate processing system of claim 47, wherein the dispensing component is structured to dispense one or more fluidic materials.

66. The multi-well plate processing system of claim 47, wherein the dispensing component is structured to dispense the materials to a plurality of multi-well plates substantially simultaneously.

67. The multi-well plate processing system of claim 47, wherein the dispensing component comprises at least one dispenser that is angled relative to a Z-axis.

68. The multi-well plate processing system of claim 47, further comprising at least one trap that is operably connected to the material removal component, which trap is structured to trap waste material that is removed from the wells of a multi-well plate.

69. The multi-well plate processing system of claim 47, further comprising at least one robotic gripping component that is structured to grip and translocate multi-well plates between components of the multi-well plate processing system and/or between the multi-well plate processing system and another location.

70. The multi-well plate processing system of claim 47, further comprising at least one multi-well plate storage component that is structured to store one or more multi-well plates.

71. The multi-well plate processing system of claim 47, further comprising at least one incubation component that is structured to incubate one or more multi-well plates.

72. The multi-well plate processing system of claim 47, further comprising at least one translocation component that is structured to translocate one or more of the material removal component, the positioning component, or the dispensing component relative to one another.

73. The multi-well plate processing system of claim 47, further comprising at least one washing component that is structured to wash at least a portion of the material removal component and/or the dispensing component.

74. The multi-well plate processing system of claim 47, further comprising at least one detection component that is structured to detect detectable signals produced in one or more wells disposed in one or more multi-well plates.

75. The multi-well plate processing system of claim 47, further comprising a multi-well plate moving component that is structured to move one or more multi-well plates at least relative to the material removal component.

76. The multi-well plate processing system of claim 47, wherein the material removal head comprises a plurality of tips, at least a subset of which comprises a footprint that substantially corresponds to a footprint of at least a subset of at least one line of wells disposed in a multi-well plate.

77. The multi-well plate processing system of claim 76, wherein the number of spacing regions disposed between adjacent tips in a line of tips is a multiple of the number of spacing regions disposed between adjacent wells in a corresponding line of wells disposed in the multi-well plate.

78. The multi-well plate processing system of claim 47, further comprising at least one valve operably connected to the material removal component, which valve is structured to regulate pressure flow from the negative pressure source.

79. The multi-well plate processing system of claim 78, wherein the valve comprises a solenoid valve.

80. The multi-well plate processing system of claim 47, further comprising at least one controller that is operably connected to one or more components of the multi-well plate processing system, which controller controls operation of the components.

81. The multi-well plate processing system of claim 80, wherein the controller comprises at least one computer.

82. A dispensing system, comprising:

a) at least one dispense head comprising at least one dispenser that is structured to dispense material into one or more wells of at least one multi-well plate, which dispenser is angled relative to a Z-axis so that the material is dispensed onto the sides of the wells when the dispenser is operably connected to a material source and the material is dispensed from the dispenser; and,

b) at least one positioning component that is structured to position one or more multi-well plates relative to the dispense head.

83. A method of removing material from a multi-well plate, the method comprising:

providing at least one the material removal head comprising at least one tip that:

a) comprises at least one vent opening, at least one inlet and at least one outlet, which inlet communicates with the outlet; and

b) is structured such that when the inlet is disposed proximal to a selected well from which a material is to be removed, the tip forms a barrier between the selected well and at least one adjacent well;

wherein when the outlet is operably connected to a negative pressure source, air is drawn through the vent opening and into the inlet, thereby noninvasively removing material from the selected well while the barrier prevents cross-contamination of the adjacent well;

disposing the tip proximal to at least one selected well disposed in at least one multi-well plate; and,

applying negative pressure from the negative pressure source such that material is noninvasively removed from the selected well substantially without cross-contaminating wells disposed in the multi-well plate, thereby removing material from the multi-well plate.

84. The method of claim 83, wherein the method comprises noninvasively removing materials from a plurality of multi-well plates substantially simultaneously.
85. The method of claim 83, wherein the material is fluidic material.
- 5 86. The method of claim 83, wherein the material removal head comprises at least two tips that are spaced at a distance that substantially corresponds to a distance between at least two wells disposed in the multi-well plate and the method comprises noninvasively removing materials from the wells through the inlets substantially simultaneously.
- 10 87. The method of claim 83, wherein the multi-well plate comprises 6, 12, 24, 48, 96, 192, 384, 768, 1536, or more wells.
88. The method of claim 83, wherein a cross-sectional area of the inlet is less than a cross-sectional area of the selected well.
89. The method of claim 83, wherein the negative pressure source
15 applies a pressure of at least 28.5 inches Hg at the inlet at a flow rate of at least 0.3 cubic feet per minute.
90. The method of claim 83, further comprising detecting a detectable signal produced in one or more wells of the multi-well plate using a detector.
91. The method of claim 83, further comprising:
20 disposing the inlet proximal to at least one other selected well disposed in the multi-well plate, and,
applying negative pressure from the negative pressure source such that material is noninvasively removed from the other selected well.
92. The method of claim 83, wherein at least one other material is not
25 removed from the selected well.
93. The method of claim 92, wherein the other material comprises cellular material or another non-fluidic material.

94. The method of claim 83, further comprising:
dispensing one or more materials into one or more wells using a
dispenser before or after the disposing step.

95. The method of claim 94, wherein the dispenser is angled relative to
5 a Z-axis so that the materials are dispensed onto the sides of the wells.

96. The method of claim 94, wherein the materials comprise fluidic
materials.